WHAT IS CLAIMED:

1. An isolated nucleic acid encoding an evening primrose Δ6-desaturase.

2. The isolated nucleic acid of Claim 1 comprising at least one of the nucleotide sequence of SEQ ID NO: 26 or nucleotides 49 to 1401 of SEQ ID NO: 26.

3. An isolated nucleic acid that codes for the amino acid sequence of SEQ ID NO: 27.

4. A vector comprising the nucleic acid of any one Claims 1- 3.

5. An expression vector comprising the isolated nucleic acid of any one of Claims 1-3 operably linked to a promoter which effects expression of the gene product of said isolated nucleic acid.

6. An expression vector comprising the isolated nucleic acid of any one of Claims 1-3 operably linked to a promoter and a termination signal capable of effecting expression of the gene product of said isolated nucleic acid.

7. The expression vector of Claim 5 wherein said promoter is a Δ6- desaturase promoter, an Anabaena

carboxylase promoter, a helianthinin promoter, a glycinin in promoter, a napin promoter, the 35S promoter from CaMV, a helianthinin tissue-specific promoter, an oleosin seed-specific promoter, or an albumin seed-specific promoter.

8. The expression vector of Claim 6 wherein said promoter is a Δ6-desaturase promoter, an Anabaena carboxylase promoter, a helianthinin promoter, a glycinin promoter, a napin promoter, the 35S promoter from CaMV, a helianthinin tissue-specific promoter, an oleosin seed-specific promoter, or an albumin seed-specific promoter.

9. An expression vector comprising the isolated nucleic acid of any one of Claims 1-3 operably linked to a constitutive promoter.

10. An expression vector comprising the isolated nucleic acid of any one of Claims 1-3 operably linked to a tissue specific promoter.

11. The expression vector of Claim 6 wherein said termination signal is a Synechocystis termination signal, a nopaline synthase termination signal, or a seed-specific termination signal.

12. A cell comprising the vector of Claim 4.

13. A cell comprising the vector of Claim 5.

14. A cell comprising the vector of Claim 6.

15. The cell of Claim 12 wherein said cell is an animal cell, a bacterial cell, a plant cell or a fungal cell.

16. The cell of Claim 13 wherein said cell is an animal cell, a bacterial cell, a plant cell or a fungal cell.

17. The cell of Claim 14 wherein said cell is an animal cell, a bacterial cell, a plant cell or a fungal cell.

18. A transgenic bacterium or plant comprising the isolated nucleic acid of any one of Claims 1-3.

16 19. A transgenic bacterium or plant comprising the vector of Claim 4.

17 20. A transgenic bacterium or plant comprising the vector of Claim 5.

18 21. A transgenic bacterium or plant comprising the vector of Claim 6.

22. A plant or progeny of said plant which has been regenerated from the plant cell of Claim 15.

23. The plant of Claim 19 wherein said plant is a sunflower, soybean, maize, tobacco, peanut, carrot or oil seed rape plant.

24. A method of producing a plant with increased gamma linolenic acid (GLA) content which comprises:

(a) transforming a plant cell with the isolated nucleic acid of any one of Claims 1-3; and

(b) regenerating a plant with increased GLA content from said plant cell.

25. A method of producing a plant with increased gamma linolenic acid (GLA) content which comprises:

(a) transforming a plant cell with the vector of Claim 4; and

(b) regenerating a plant with increased GLA content from said plant cell.

26. A method of producing a plant with increased gamma linolenic acid (GLA) content which comprises:

(a) transforming a plant cell with the vector of Claim 5; and

(b) regenerating a plant with increased GLA content from said plant cell.

24 27. A method of producing a plant with increased gamma linolenic acid (GLA) content which comprises:

(a) transforming a plant cell with the vector of Claim 6; and

(b) regenerating a plant with increased GLA content from said plant cell.

25 28. The method of Claim 21 wherein said plant is a sunflower, soybean, maize, tobacco, peanut, carrot or oil seed rape plant.

26 29. The method of Claim 22 wherein said plant is a sunflower, soybean, maize, tobacco, peanut, carrot or oil seed rape plant.

27 30. The method of Claim 23 wherein said plant is a sunflower, soybean, maize, tobacco, peanut, carrot or oil seed rape plant.

28 31. The method of Claim 24 wherein said plant is a sunflower, soybean, maize, tobacco, peanut, carrot or oil seed rape plant.

Sub A6 32. A method of inducing or increasing production of gamma linolenic acid (GLA) in an organism

lacking in or producing low levels of GLA which comprises transforming said organism with the isolated nucleic acid of any one of Claims 1-3.

33. A method of inducing or increasing production of gamma linolenic acid (GLA) in an organism deficient or lacking in or producing low levels of GLA which comprises transforming said organism with the vector of Claim 4.

34. A method of inducing or increasing production of gamma linolenic acid (GLA) in an organism deficient or lacking in or producing low levels of GLA which comprises transforming said organism with the vector of Claim 5.

35. A method of inducing or increasing production of gamma linolenic acid (GLA) in an organism deficient or lacking in or producing low levels of GLA which comprises transforming said organism with the vector of Claim 6.

36. A method of inducing production of gamma linolenic acid (GLA) in an organism deficient or lacking in or producing low levels of GLA and linoleic acid (LA) which comprises transforming said organism with an isolated nucleic acid encoding bacterial Δ6-desaturase and an isolated nucleic acid encoding Δ12-desaturase.

37. A method of inducing production of gamma linolenic acid (GLA) in an organism deficient or lacking in or producing low levels of GLA and linoleic acid (LA) which comprises transforming said organism with at least one expression vector comprising an isolated nucleic acid encoding evening primrose Δ6-desaturase and an isolated nucleic acid encoding Δ12-desaturase.

38. The method of inducing production of octadecatetraeonic acid in at least one of a plant deficient or lacking in or producing low levels of octadecatetraenoic acid, a bacterium which produces α-linolenic acid, or a bacterium which exhibits a Δ15-desaturase activity on a GLA substrate which comprises transforming said plant or bacterium with any one of Claims 1-3.

39. A method of inducing production of octadecatetraeonic acid in at least one of a plant deficient or lacking in or producing low levels of octadecatetraenoic acid, a bacterium which produces α-linolenic acid, or a bacterium which exhibits a Δ15-desaturase activity on a GLA substrate which comprises transforming said plant or bacterium with the vector of Claim ~~4.~~

40. A method of inducing production of octadecatetraeonic acid in at least one of a plant

deficient or lacking in or producing low levels of octadecatetraenoic acid, a bacterium which produces α-linolenic acid, or a bacterium which exhibits a Δ15-desaturase activity on a GLA substrate which comprises transforming said plant or bacterium with the vector of Claim 5.

41. A method of inducing production of octadecatetraeonic acid in at least one of a plant deficient or lacking in or producing low levels of octadecatetraenoic acid, a bacterium which produces α-linolenic acid, or a bacterium which exhibits a Δ15-desaturase activity on a GLA substrate which comprises transforming said plant or bacterium with the vector of Claim 6.

42. A method of inducing production of octadecatetraeonic acid in at least one of a plant deficient or lacking in or producing low levels of octadecatetraenoic acid, a bacterium which produces α-linolenic acid, or a bacterium which exhibits a Δ15-desaturase activity on a GLA substrate which comprises transforming said plant or bacterium with the vector of Claim 7.

43. The method of Claim 40 wherein said plant is a sunflower, soybean, maize, tobacco, peanut, carrot or oil seed rape plant.

44. The method of Claim 41 wherein said plant is a sunflower, soybean, maize, tobacco, peanut, carrot or oil seed rape plant.

45. The method of Claim 42 wherein said plant is a sunflower, soybean, maize, tobacco, peanut, carrot or oil seed rape plant.

46. The method of Claim 43 wherein said plant is a sunflower, soybean, maize, tobacco, peanut, carrot or oil seed rape plant.